What do you mean I do not have enough information on instream flow requirements to support our position – Key science gaps from the perspective of a natural resource agency

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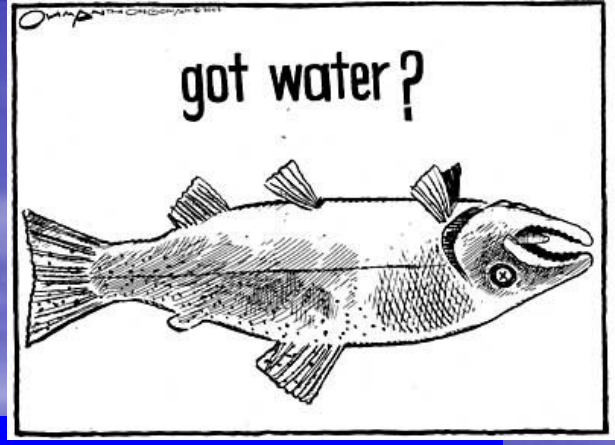
INSTREAM FLOW COUNCIL

Michigan DNR

Objectives

- Legal and Quasi-Legal Framework
- Status of the Science
- Key Gaps
  - Biological
  - Physical
  - Socioeconomic

Institutional Framework



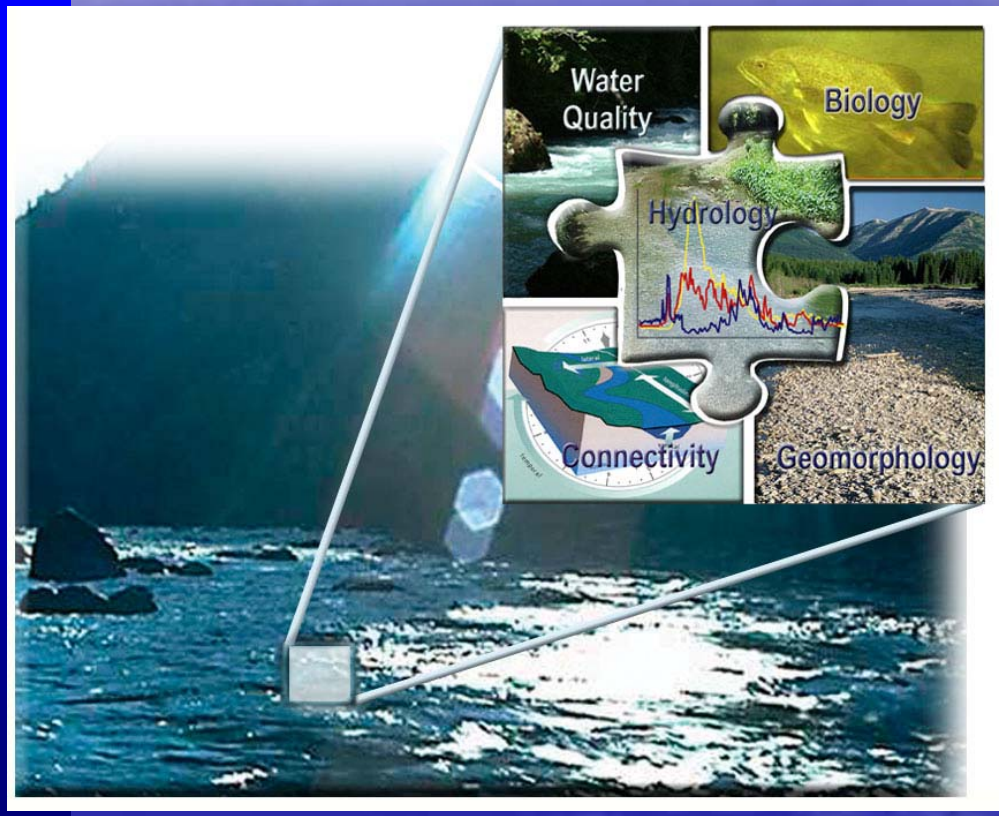
- Public Trust Doctrine - State resource agencies are the public resource trustee.
  - Directly responsible for the commonly held fish and wildlife resources
- Required to protect natural resources
  - Key involvement
    - Water adjudication proceedings
    - Developmental permits - state or federal
    - FERC proceedings

Institutional Framework

- "Rules" of the Game
  - Must have substantial evidence to support recommendations.
    - Closer to the source of the proceedings the better
      - Site specific information is the best
  - You will be challenged by the project owners or developers and their agents.
    - Often leads to court action
  - Failures in these proceedings can be traced to our key understanding gaps.

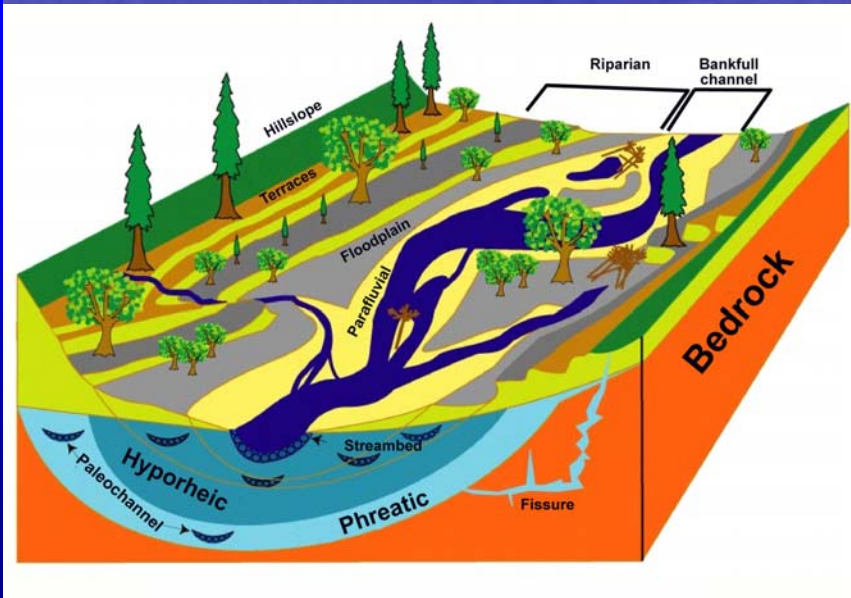
Status of the Science

- We know a fair amount about how aquatic systems work but much is theoretical and not site-specific



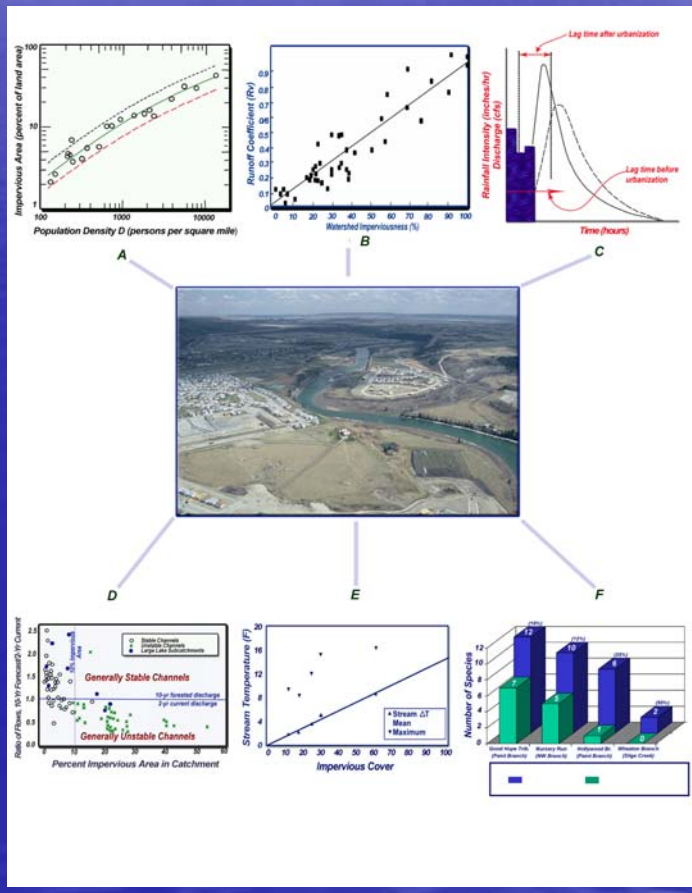
Status of the Science

- Fundamental understandings of flow dynamics, water chemistry, sediment transport, and aquatic community functioning all exist.



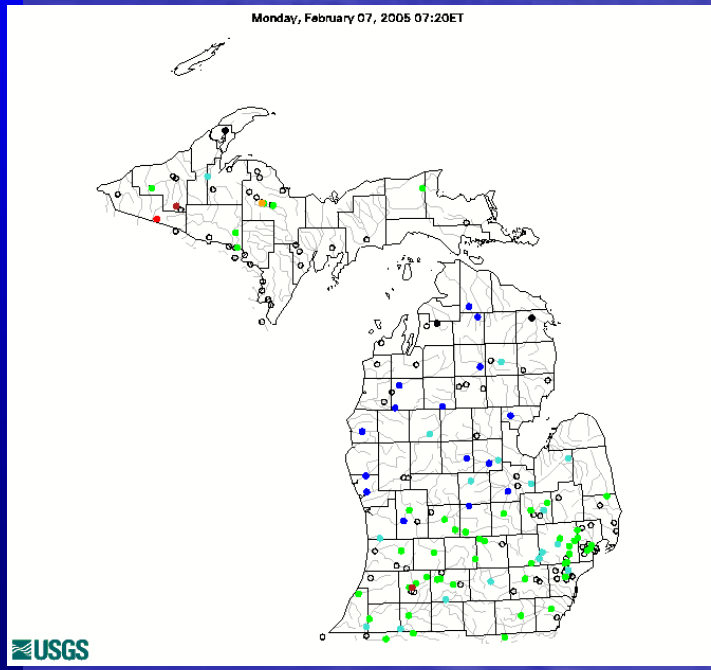
Status of the Science

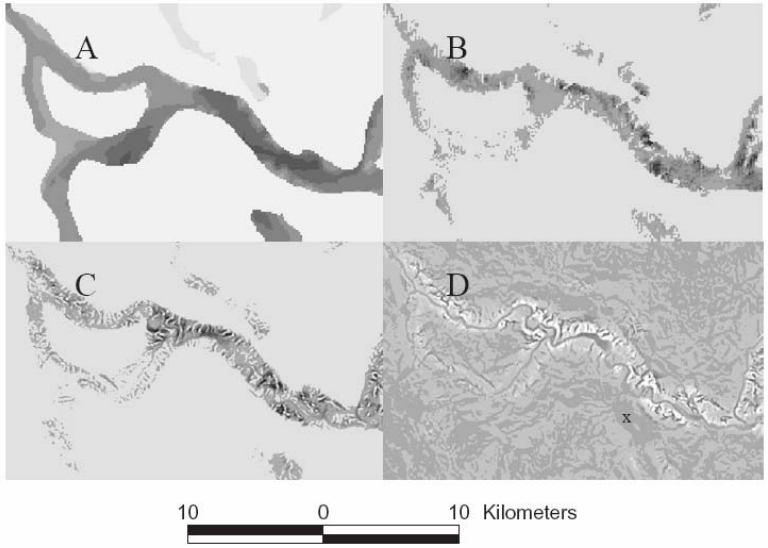
- Hydrograph
  - Good models are available in many parts of the country to predict flows from a range of variables but critical stream gauges to calibrate models are missing in many areas.

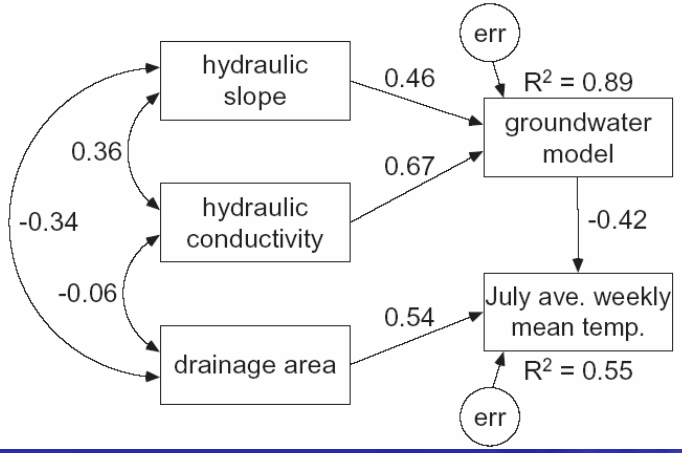


Status of the Science

- Discharge dynamics
  - In Michigan, there are approx. 140 stream gauges and good-excellent synthetic hydrograph generating models that incorporate surficial geology and groundwater movement.
  - But the understanding of historic flow dynamics is limited as is the modeling of all storage systems.







GIS models predicting groundwater inputs, discharge and high-level habitat effects for Michigan streams. From Baker et al. 2003

Status of the Science

- Discharge dynamics
  - Understanding of historic flow dynamics is limited as is the modeling of storage systems.

Status of the Science

- Water Chemistry
  - Good-excellent models exist to predict selected temperature characteristics based on the surficial geology, groundwater inputs and hydrograph.
  - Good temperature-aquatic community relationships exist that provide the likely aquatic community composition but these still require refinement.
  - Models for other characteristics such as DO and turbidity range from fair to good.

Minimum July Temp

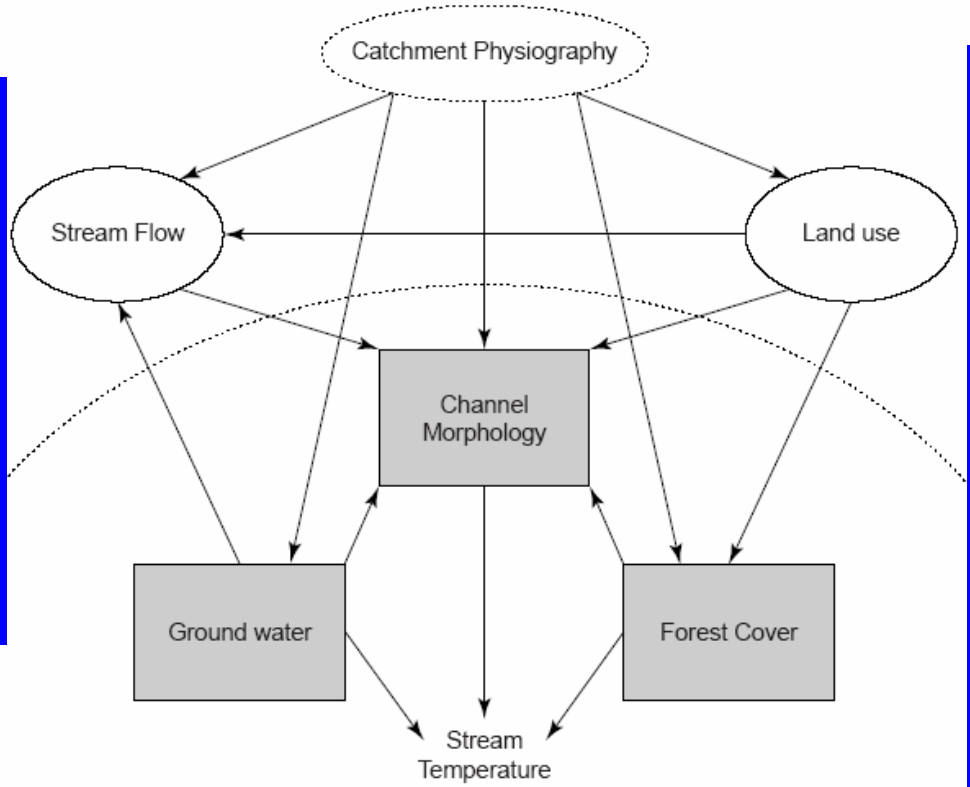
R^2= 0.80, N=151

Channel Width

Forest Cover

Min Air Temp

Max Air Temp



Maximum July Temp

R^2= 0.71, N=151

Channel Width

Forest Cover

Network GW

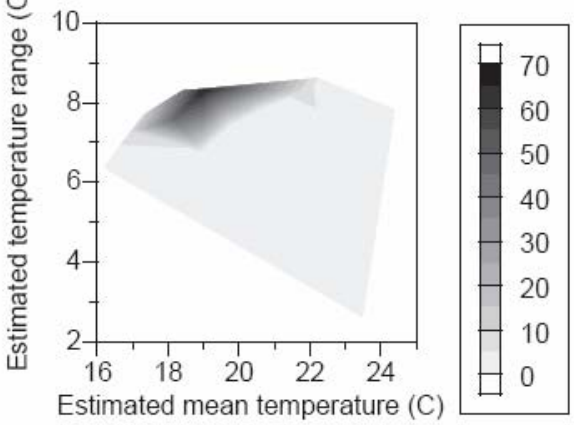
Local GW

Reach Gradient

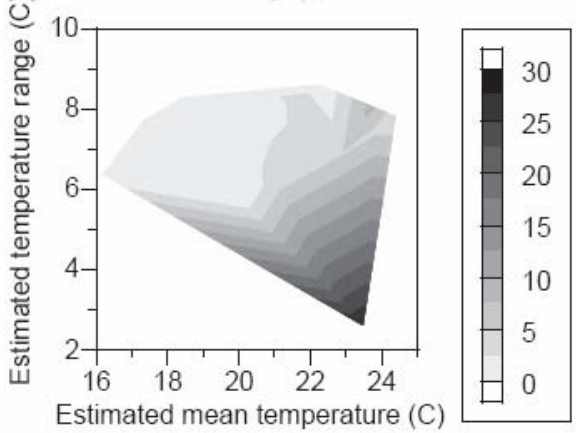
Channel Area

Conceptual model for developing stream temperature characteristics from Michigan watershed variables. From Wehrly et al. 1997.

Creek Chub



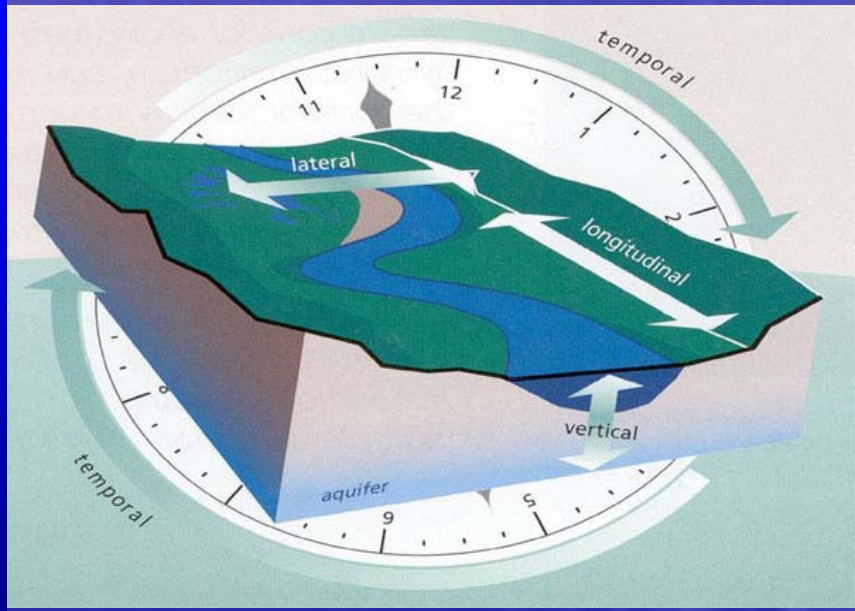
Channel Catfish



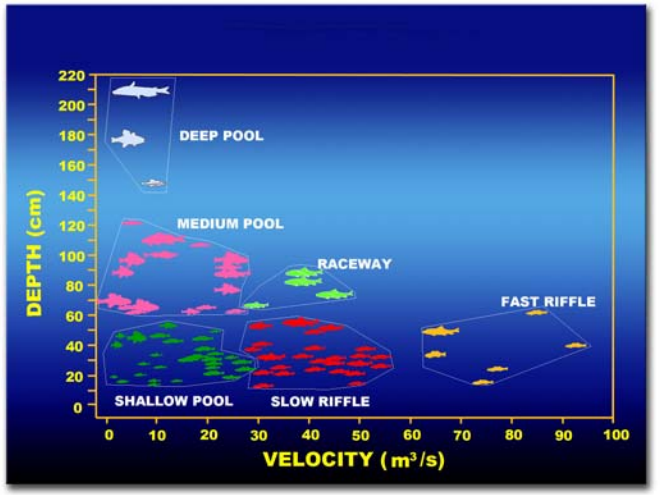
Average abundances (in kg/ha) of creek chub and channel catfish on axes of predicted mean and range in July weekly temperature. From Zorn et al. 1998.

Status of the Science

- Channel Form and Processes
  - Rudimentary higher scale models exist currently but provide little predictive value at this time.
  - Less is known about the historical channel shapes.



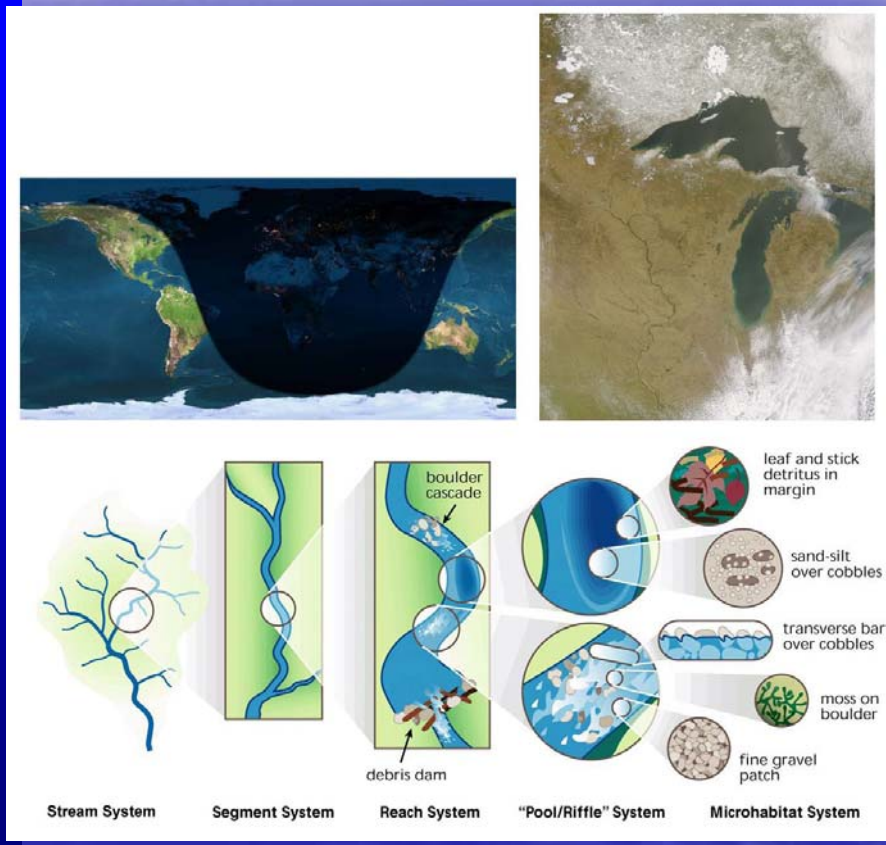
Status of the Science



- Aquatic Communities
  - Much work has been done on macro- and micro-habitat requirements of many species.
    - Fair-good predictive abilities between gross habitat factors and aquatic communities.
    - Information is often site-specific with unknown extrapolation abilities for these models.
  - Limited data exists on whole community functioning with respect to habitat composition.

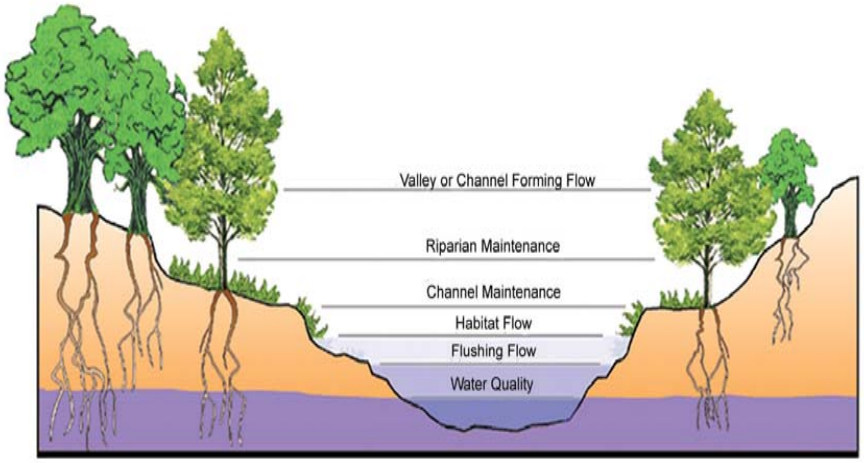
Key Gaps

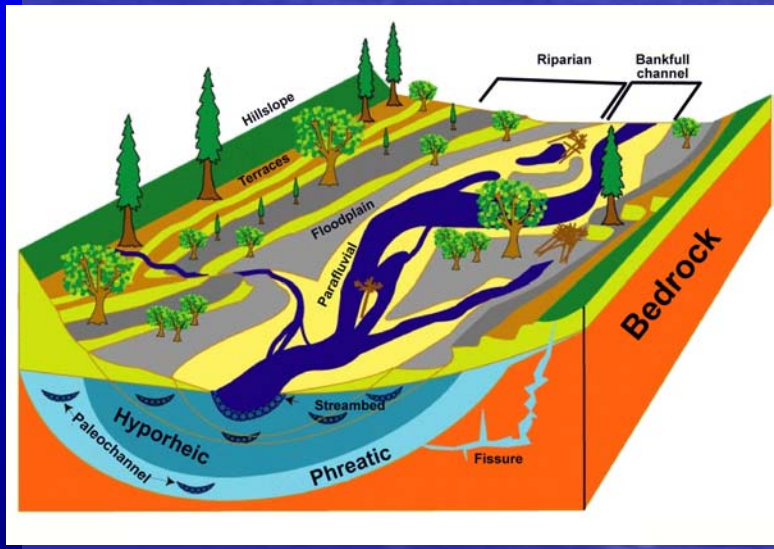
- Stream processes and discharge - Scaling
  - We have a poor understanding and few usable models are unavailable to understand the required flows to maintain stream processes at multiple scales



Key Gaps

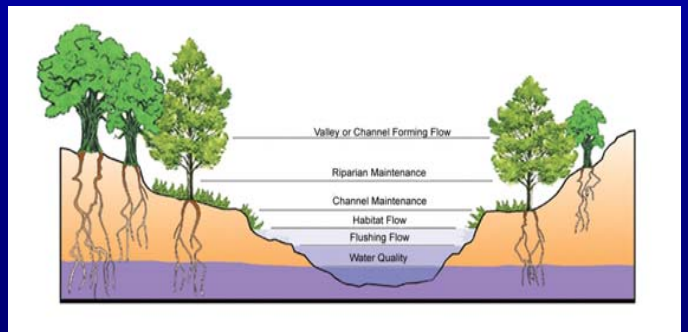
- Stream processes and discharge
  - We need tools to determine how much water is needed to maintain or rehabilitate stream reaches with respect to sediment and woody debris transport, and channel structure formation.
    - All of these components are key aquatic habitat processes

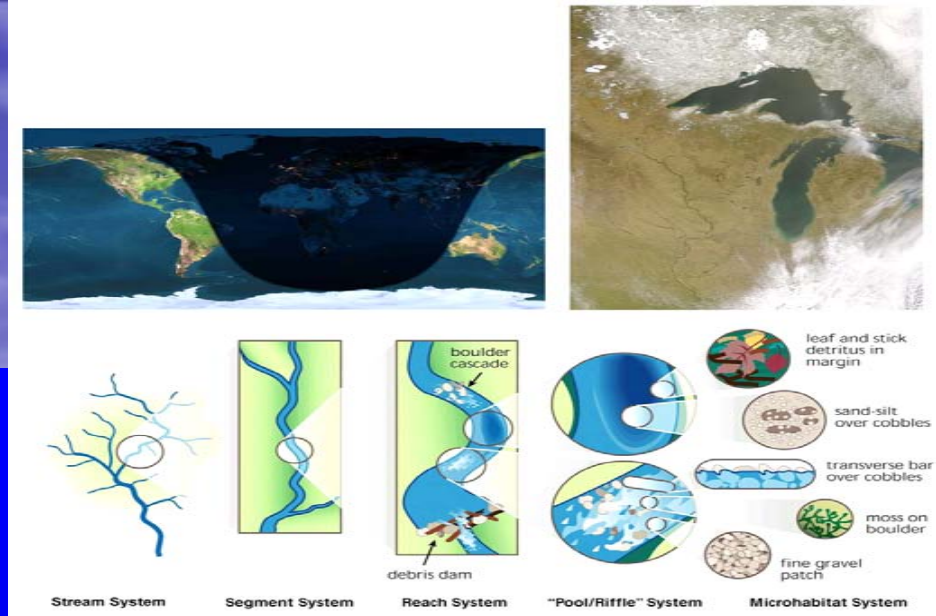


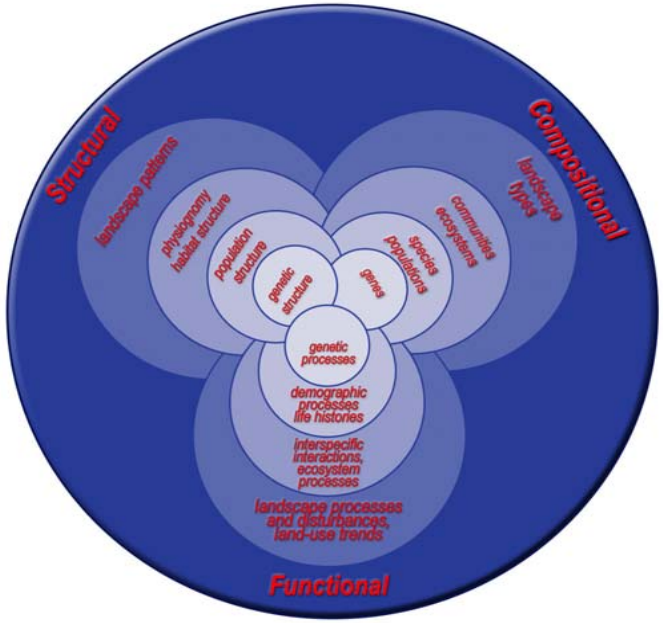


Key Gaps

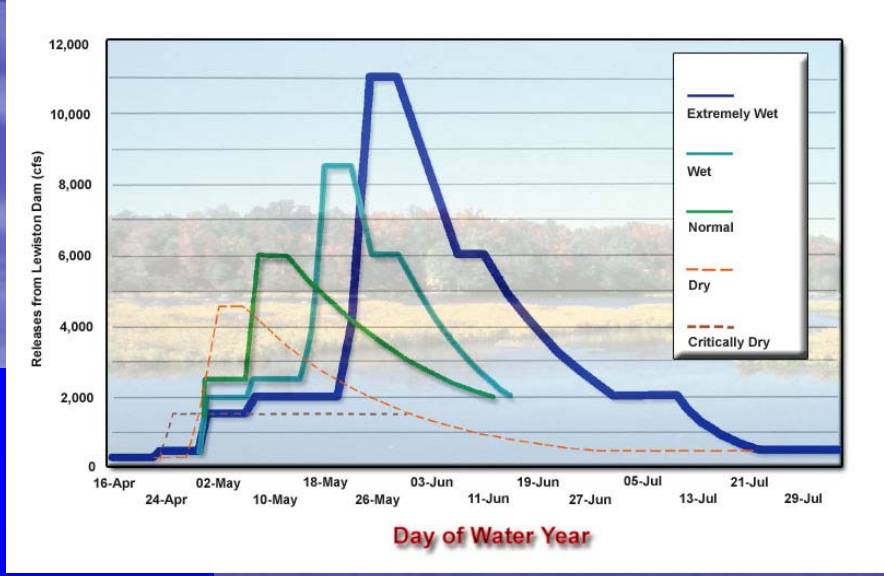
- Stream Processes
  - We to need know not just how much flow but of what duration is required to maintain and rehabilitate stream processes.
    - Timing, duration and magnitude of flows to maintain streams at all scales



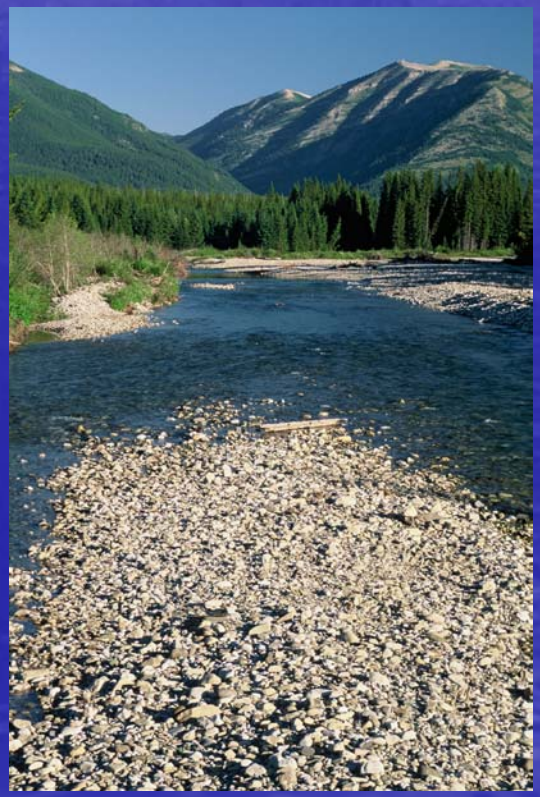




Key Gaps



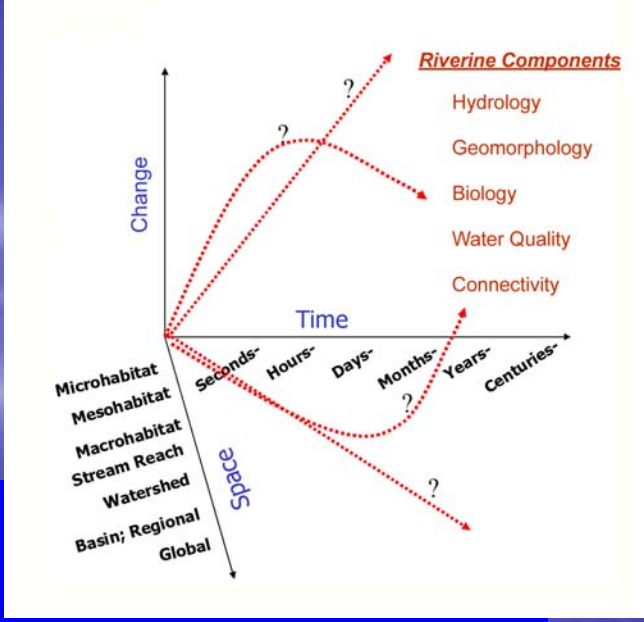
- Stream Processes
  - Little information has been developed with respect to how existing instream flow and hydrograph recommendations have worked or not.
    - Few long-term datasets exist on stream processes.
  - Easy to apply assessment tools for each process is needed that will stand up in court are not available.



Key Gaps

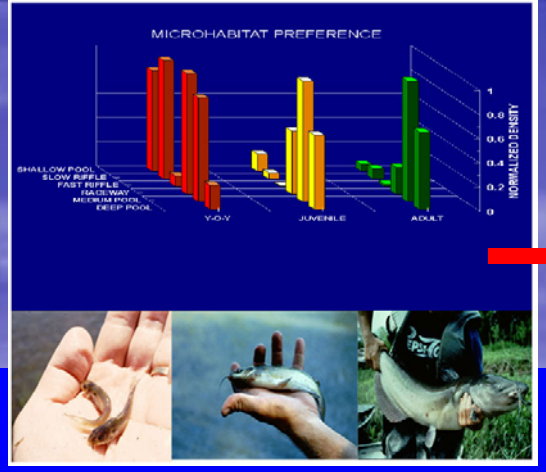
- Aquatic communities
  - We need detailed but intelligible tools to relate stream processes and habitat to aquatic communities.
    - The universe is known but precise site-specific data usually does not exist.
  - It is critical to understand temporal and spatial variability in aquatic communities.
    - We need relationships to model year class strengths at all levels of the aquatic community.
    - We need relationships to model how aquatic communities move in a watershed and the meaning of these movements.

Key Gaps



- Aquatic Communities
  - We need to know how aquatic communities function on short- and long term time scales within the discharge and habitat constraints placed on them.
  - We need intelligible tools that fully incorporate population dynamics into watershed and instream flow analysis are needed.

Key Gaps



- Socioeconomic
  - We need tools to help citizens understand how watersheds and streams function.
  - We need strategies to help state resource agencies mobilize citizens and enable them to be informed stewards/guardians.
  - It is essential to develop intelligible economic models and tools to allow state resource agencies to evaluate the value of the resource.
    - This is the key to successfully implementing sound watershed management strategies.

Status Summary

- We have fundamental knowledge about both the physical and biological components of instream flow science.
  - We have crude models that define the flow-habitat-aquatic community universe.
- We need much more detailed but easily understood models and approaches to understand stream processes.
  - These will lead to more accurate estimates of how aquatic communities respond to flow regimes.

Status Summary

- It is critical that we do not ignore the socioeconomic side of watershed and instream flow management.
  - We need to understand our public, their knowledge, and what they are thinking.
  - We need to be able to influence them and motivate them to be better stewards.
  - We need to be able to communicate the true and full costs of the decisions being made.